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GCSE (9-1)

Examiners' report

GATEWAY SCIENCE COMBINED SCIENCE A

J250
For first teaching in 2016

J250/08 Summer 2019 series

Version 1

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

Paper 8 series overview

J250/08 is the second of two higher tier papers that determine the Biology content of the GCSE (9-1) Gateway Combined Science A course. It assesses content from specification topics B4-B6 and B7. This paper is synoptic and so does contain material covered by topics B1-3. There are also questions that involve the assessment of key mathematical requirements from Appendix 5f of the specification.

Section A overview

Section A consisted of multiple-choice questions. It was encouraging to see that most candidates attempted all these questions. Of these questions, candidates tended to do better on Questions 4, 6, 8 and 9 and less well on Questions 5, 7 and 10.

Question 5

5 Which is the best technique to investigate the effect of shade from a tree on the types of plants growing in a field?

A Capture-recapture

B Line transect

C Pitfall traps

D Quadrat sampling in a grid

Your answer ☐ **[1]**

Higher ability candidates were able to identify the line transect as the correct technique. Many candidates incorrectly thought the answer was D.

Question 7

7 MRSA is a type of bacteria that cannot be treated with most antibiotics.

How has MRSA developed?

A Genetic engineering

B Natural selection

C Protein synthesis

D Selective breeding

Your answer ☐ **[1]**

A majority of candidates were able to correctly identify natural selection. However, those that did not tendered to incorrectly assume it was selective breeding.

Question 10

10 New drugs are tested using preclinical trials.

Which statement describes a preclinical trial?

A One group of volunteers are given a placebo, another group the drug.

B The drug is tested on human cells.

C Volunteers are given a placebo only.

D Volunteers are given the new drug.

Your answer ☐ **[1]**

Preclinical trials are part of the process involved in developing new medicines. The process involves testing the drugs in laboratory situations before they are tested on patients. Many candidates incorrectly assumed that the volunteers were given the new drug, which is part of the clinical trials.

Section B overview

Section B consisted of structured questions ranging from 1 to 6 marks. There was clear evidence of knowledge and understanding (AO1). Candidates did not perform as well when required to apply their knowledge to answer questions (AO2) or analyse information and ideas (AO3).

Throughout Section B a large proportion of the candidates provided very long answers that tended to repeat what they had already said and, in some cases, contradicted their answers. They should be encouraged to use the number of lines within a question as a guide to the length of answer required.

The additional pages at the back of the paper are available for those candidates who do need extra room to answer a question. However some candidates still think they need to use the additional pages to write one word that could have easily fitted onto the end of a line. Candidates should also be encouraged to number any answers on the additional pages correctly; this will help the examiner give appropriate credit.

Question 11 (a)

11 (a) Water is cycled in nature.

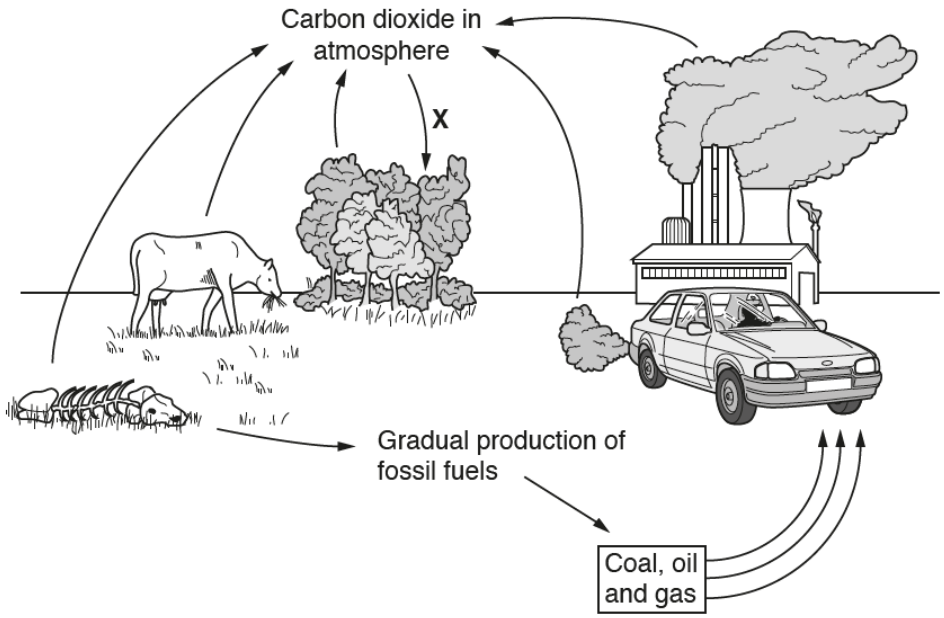
Name **one** abiotic factor that affects water uptake by a plant.

..... **[1]**

Most of the candidates could identify one abiotic factor. Some confused abiotic with biotic and incorrectly assumed photosynthesis was an answer.

Question 11 (b) (i)

(b) Look at the diagram of the carbon cycle.



(i) Which process is shown by arrow **X** in the diagram?

Tick (✓) **one** box.

- Combustion ☐
- Decomposition ☐
- Photosynthesis ☐
- Respiration ☐

[1]

This was successfully answered correctly by most candidates. A few exceptions assumed the answer was respiration.

Question 11 (b) (ii)

(ii) Which process releases carbon when organisms **die**?

Tick (✓) **one** box.

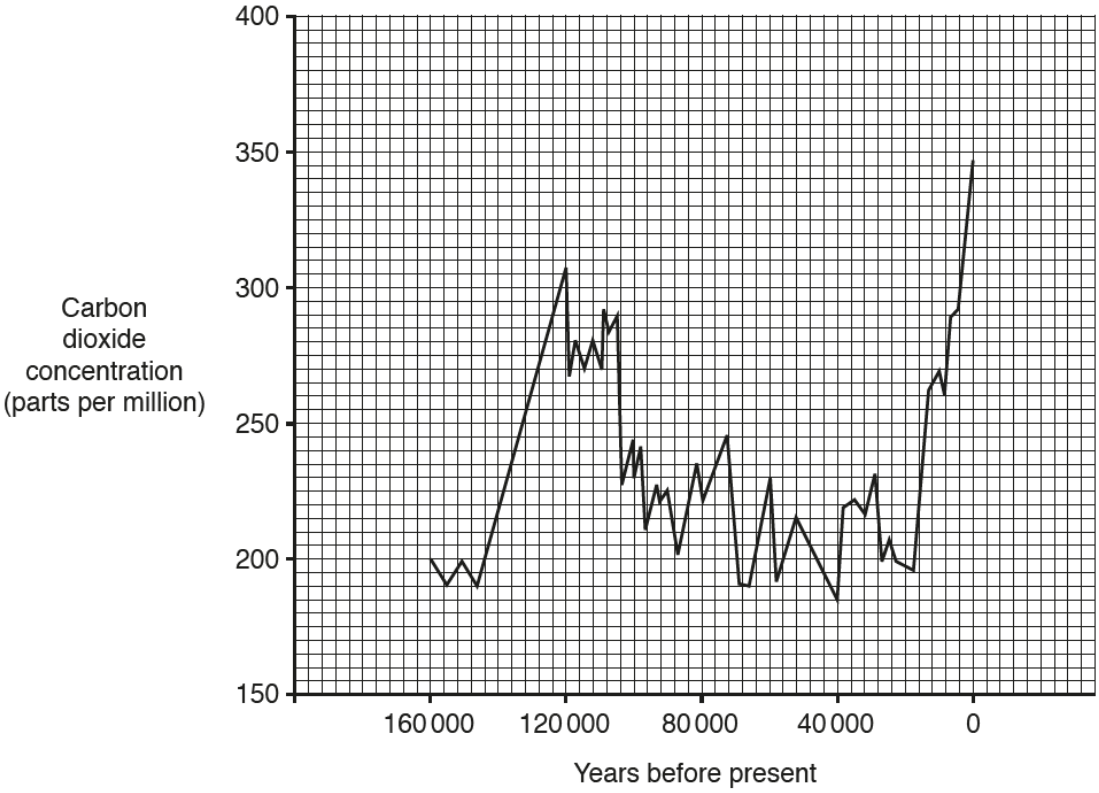
- Combustion ☐
- Decomposition ☐
- Photosynthesis ☐
- Transpiration ☐

[1]

This was successfully answered correctly by most candidates. A few exceptions assumed the answer was combustion.

Question 11 (c) (i)

(c) The graph shows how carbon dioxide levels in the atmosphere have changed during the last 160 000 years.



(i) Read this statement:

Carbon dioxide levels in the atmosphere are rising out of control.

What evidence is there in the graph for and against this statement?

for .....

.....

against .....

.....

[2]

Most of the candidates were credited with at least one mark. Those that did not get both marks tended to provide general references to increases or identifying the increase 120,000 years ago and did not mention the recent increase. A few candidates provide the evidence the wrong way around suggesting that the fluctuations were evidence 'for', and the recent increase was evidence 'against'.

Question 11 (c) (ii)

(ii) Look at the section of the graph for the last 20 000 years.

What conclusion can be made about the release of carbon dioxide into the atmosphere and also its removal from the atmosphere during the last 20 000 years?

.....

.....

.....

..... **[2]**

Higher ability candidates showed a clear understanding that more carbon dioxide was being released than being removed. Lower ability candidates tended to just describe the trends in the graph and therefore could not be credited with any marks.

Question 11 (c) (iii)

(iii) Describe how human activity has contributed to the trends in the graph and suggest how this activity could affect biodiversity.

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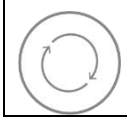
..... **[3]**

Higher ability candidates were able to provide a well-constructed answer for 3 marks. For the first marking point candidates tended to be given credit for mentioning deforestation. Very few gained a mark for increased burning of fossil fuels as they did not include the idea of an increase; instead they just referred to the use of fossil fuels.

	**AfL**	Candidates should be encouraged to make comparisons when interpreting data. The use of the words 'more' or 'less' can be the difference between being credited and not being credited with a mark.

Exemplar 1

Human activity such as deforestation would have made this worse. This is because ~~cards~~ they remove trees which is bad as trees remove CO_2 from the atmosphere through photosynthesis. This decreases biodiversity as habitats are loss which can lead to the death of species. Pollution is also due to human activity. [3]

This response is from a higher attaining candidate and shows a clear understanding of how human activity has contributed to the trends in the graph. They have used the idea of deforestation to explain that this would decrease biodiversity due to habitat loss. The candidate had mentioned that habitat loss would lead to 'death of species'. It should be noted that 'death of species' is insufficient for the idea of 'extinction'. As this candidate had already been credited with maximum marks this was not an issue in this case.

Many candidates did not state that there would be a reduction in biodiversity but simply repeated the stem of the question by saying it would be affected.

Question 11 (d)

(d) The information in the box is part of a scientific journal report.

> **Growing crops with shiny leaves could cause an annual global cooling of over 0.1 °C.**
>
> **This is almost 20% of the total global temperature increase since the Industrial Revolution.**

Most crop plants have non-shiny leaves.

A few varieties of crop plants do have shiny leaves but they do **not** all produce high yields.

Explain how scientists could use selective breeding to help reduce global temperatures.

.....

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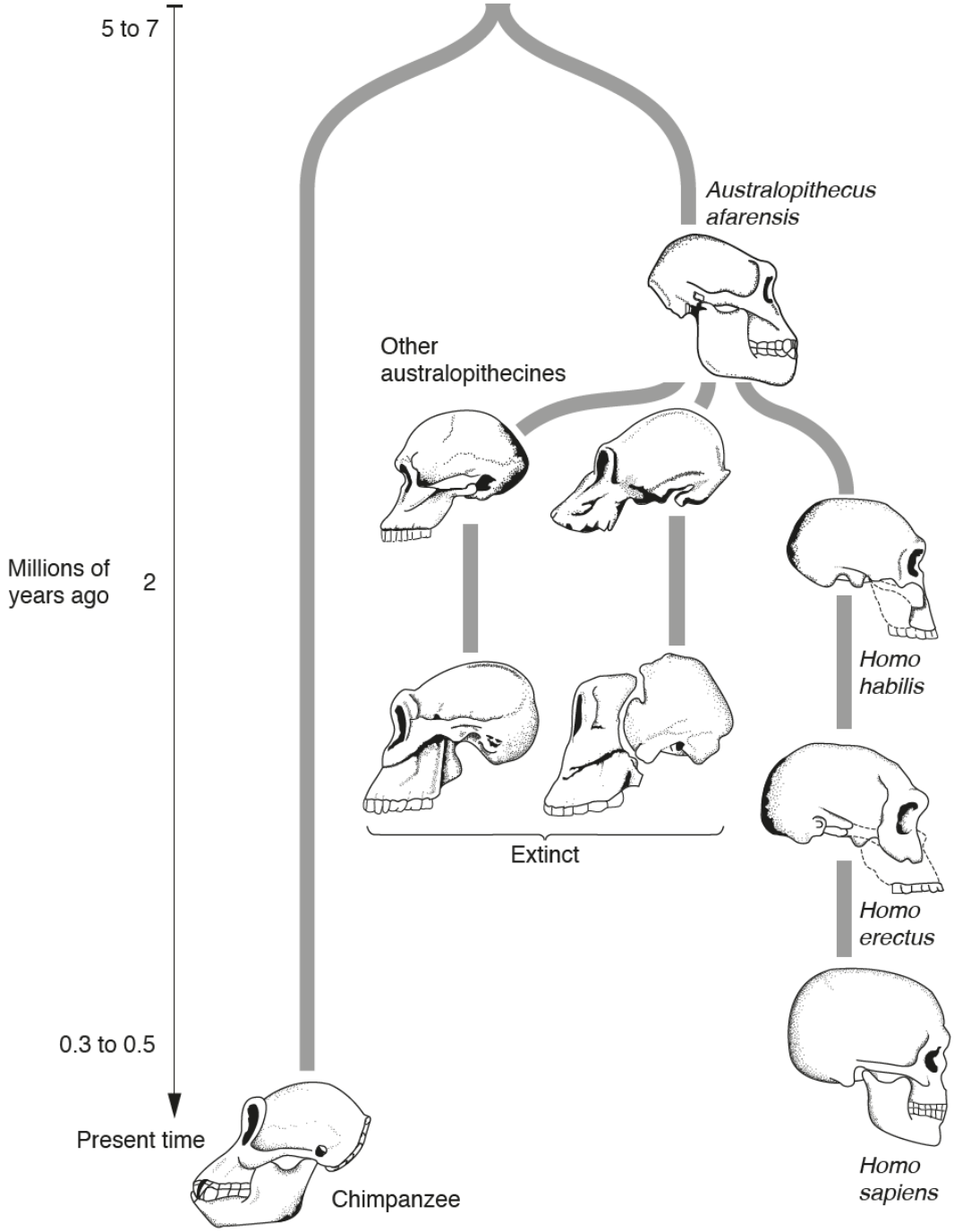
..... **[2]**

Most of the candidates realised that they needed to breed plants with shiny leaves, however they did not realise that high yield was important. Some candidates missed the term 'selective breeding' and answered using ideas about genetic engineering.

Question 12 (a)

12* (a) Look at the diagram, it shows how humans, *Homo sapiens*, evolved.

It also shows that humans are closely related to other apes, like chimpanzees.



Describe how humans, *Homo sapiens*, evolved from *Australopithecus afarensis* and the evidence for this shown in the diagram.

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..... **[6]**

The majority of candidates made an attempt to interpret the diagram, either by describing the evolutionary path of Homo sapiens or by comparing skull structure. The lower ability candidates tended not to develop their answer to describe the process of natural selection.

Exemplar 2

Homosapiens evolved from Australopithecus afarensis by variation. This is when a mutation occurs and ~~what~~ has an advantageous phenotype ~~so it is~~ they are more likely to survive and reproduce. They then pass on the mutation to their offspring, who is also more likely to survive and reproduce. This process continues until ~~of the species~~ a new species who share the mutation is formed. This is shown in the diagram through the changing structures of the skull, as the head has enlarged, the teeth have increased / straightened, and the jaw is straightened and no longer protrudes. **[6]**

This candidate provides a clear description of the process of natural selection. They have included ideas about mutations causing variation within a species and then gone on to include survival of the fittest and the evolution of a new species. Finally, they have used the diagram to provide evidence in the form of changes to the structure of the skull. They were credited Level 3, 6 marks for this answer.

Question 12 (b) (i)

(b) (i) Describe how the use of DNA in phylogenetics has changed classification systems.

.....

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..... **[2]**

Only the higher ability candidates were able to answer in terms of comparing similarities in DNA to find common ancestors or classify species.

?	**Misconception**	Many candidates confused the idea of using DNA to classify species with ideas about natural classification and artificial classification. Artificial classification is the grouping of organisms based on non-evolutionary features; for example, classifying plants into the same group because they have the same number of stamen. Natural classification uses the evolutionary links between species which may involve comparing DNA but may also involve the fossil record. So candidates that assumed the use of DNA meant that organisms were classified by natural classification rather than artificial could not be given credit.

Question 12 (b) (ii)

(ii) How does the structure of DNA support its use in phylogenetics?

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.....

.....

..... **[2]**

Only the higher ability candidates showed some understanding of how similarities in the sequence of bases or the DNA code could be used to identify common ancestors or evolutionary relationships.

Question 13 (a) (i)

13 (a) HIV is a virus that causes AIDS.

Some countries have set up centres where a person is counselled and tested for HIV.

The aim is to reduce new infections by 50%.

(i) Write down **two** types of testing that can be done to identify someone with HIV.

1 .....

.....

2 .....

.....

[2]

Most candidates were credited with one mark for the idea that testing blood would be involved. Only the higher ability candidates apply their knowledge of reducing the spread of communicable diseases (B6.3e) to include ideas about detection of antigens or looking for visual symptoms.

Question 13 (a) (ii)

(ii) Humans who contract HIV do not die from the virus. Instead they die from AIDS-related diseases such as tuberculosis (TB).

HIV infects human cells by inserting genes into the cells. The human cells then copy the genes.

TB is caused by bacteria that infect the lungs.

Explain why a person with HIV is more likely to die from TB than a person without HIV.

Use ideas about the immune system in your answer.

.....

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.....

.....

..... **[4]**

This question showed good discrimination between abilities. Lower ability candidates tended to gain one mark for the idea of a weakened immune system. Higher ability candidates could then expand on this to explain how the invasion of white blood cells by HIV would prevent the white blood cells producing antibodies to destroy any TB bacteria that entered the body.

?	**Misconception**	Lower ability candidates incorrectly assumed that the immune system would not be able to defend against TB as it was too busy defending against HIV.

	AfL	Candidates should be encouraged to explain the role of the immune system in terms of pathogens, antibodies and antigens. They should try and avoid phrases such as 'fights the disease' or 'attacks the disease'. Instead use phrases such as 'white blood cells destroy the bacteria' or 'engulf pathogen'.

Question 13 (b)

(b) HIV can be transmitted during unprotected sexual intercourse.

Name **one** method of contraception and explain why it prevents the transmission of HIV.

Name of method of contraception .....

Why it prevents the transmission of HIV .....

..... **[2]**

Candidates usually provided a correct method of contraception such as the condom. A few candidates did not get the second mark as they did not mention bodily fluids. Some incorrectly assumed that preventing skin to skin contact was important or that the sperm carried the HIV inside them.

Question 13 (c) (i)

(c) (i) Scientists are trying to develop a vaccine against HIV.

Explain how a vaccine could protect people against HIV.

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.....

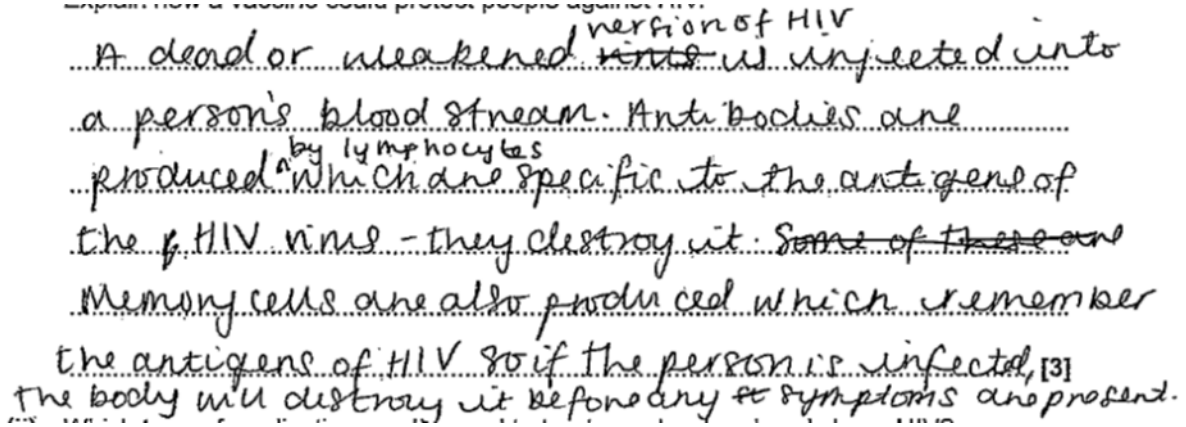
.....

..... **[3]**

This question was answered very well by higher ability candidates. They would show a clear understanding of how a vaccine worked by applying their knowledge of the immune system and the role of white blood cells.

	Misconception	Lower ability candidates often did not gain marking point one as they just mentioned that the vaccine contained small amounts of the virus or disease. To be credited with the mark they needed to say it contained a weakened or dead or harmless form of the virus. As with Q13(a)(ii) candidates should be encouraged to answer in terms of pathogens and not disease. Therefore 'contains a weakened form of the disease' was not enough to gain credit.

Exemplar 3



This response shows a well-constructed answer to the question that was credited with full marks. They have the idea that the vaccine contains a weakened form of the virus as 'HIV' was accepted as an alternative to pathogen. They then go onto explain that white blood cells will produce antibodies and that memory cells are produced. The candidate uses the term lymphocyte, which at this level is not required as an alternative to white blood cells; it was accepted as an alternative to white blood cell.

Question 13 (c) (ii)

(ii) Which **type** of medication can be used to treat people who already have HIV?

..... **[1]**

Many candidates incorrectly assumed the answer to this question was antibiotics rather than antivirals.

Question 14 (a)

14 (a) Plant material decomposes to make compost.

Gardeners add compost to their soil to increase crop yield.

Give **one** reason why compost increases crop yield.

.....

..... **[1]**

The majority of candidates were credited with a mark here. Some candidates just mentioned microorganism or decomposers being present; this was insufficient to gain credit.

Question 14 (b) (i)

(b) Gardeners use compost activator to speed up the decomposition of plant material.

Compost activator contains bacteria.

Scientists are developing a new compost activator. To do this they need to isolate samples of bacteria.

They prepare agar jelly plates containing streaks of different bacteria. **Fig. 14.1** shows a scientist preparing an agar jelly plate.

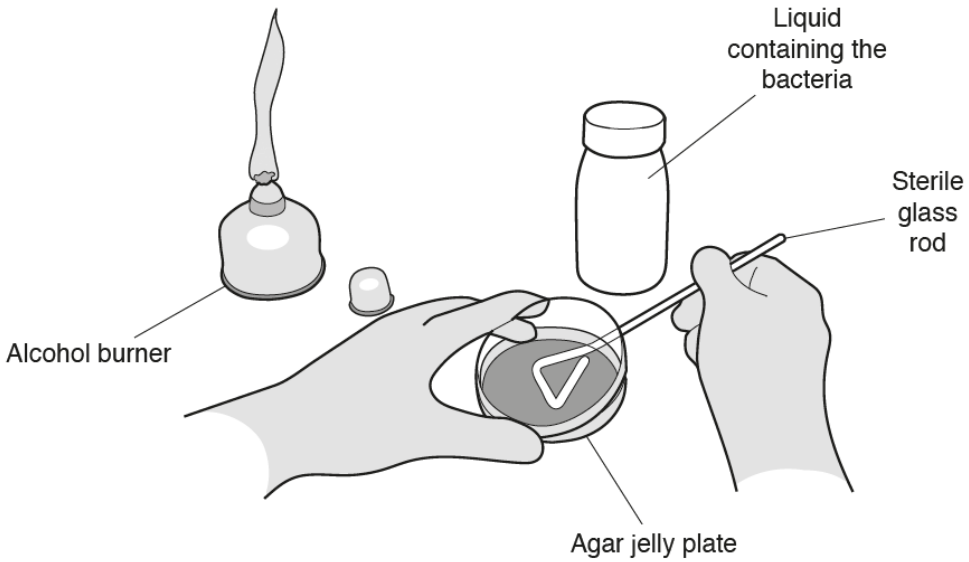


Fig. 14.1

(i) In **Fig. 14.1** the scientist uses a sterile glass rod to transfer the bacteria.

Suggest why this is better than just pouring the liquid directly from the bottle.

.....

.....

.....

..... **[2]**

The majority of the candidates gained one mark for the idea of being able to transfer small amounts of bacteria. Only the higher ability gained a second mark for clearly stating ideas about contamination from the rim of the bottle. Lower ability candidates assumed the inside of the bottle would be contaminated or that contamination would come for the surrounding air.

Question 14 (b) (ii)

(ii) Some bacteria grow faster at 37 °C than at 25 °C.

The scientist chooses to grow the bacteria at 25 °C.

Suggest why this would be safer than growing them at 37 °C.

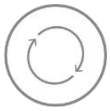
.....

.....

.....

..... **[2]**

Only the higher ability candidates gained credit for answers on this question. Most candidates assumed the increase in temperature would lead to denaturing of enzymes or out of control growth of bacteria.

	**AfL**	Microbiological techniques are part of PAG B5. Centres are encouraged to teach the risks of such techniques so that candidates know how to use microbes safely. Incubating at temperatures below human body temperature is one such safety precaution.

Question 14 (c)

(c) The scientist observes some of the bacteria growing on the agar plates using a light microscope.

The diagram in **Fig. 14.2** shows a bacterium cell.

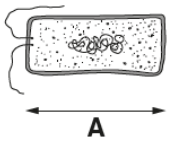


Fig. 14.2

The length (**A**) of the bacterium in **Fig. 14.2** has been magnified 2500×.

What is the actual length of the bacterium?

Give your answer in **standard form**.

Actual length = ... mm **[2]**

Most candidates were able to calculate the actual length of the bacterium. Many candidates did not read the question carefully and measured in cm when the answer line requires an answer in mm. These candidates were then out by a factor of 10 but were credited with one mark.

Question 14 (d) (i)

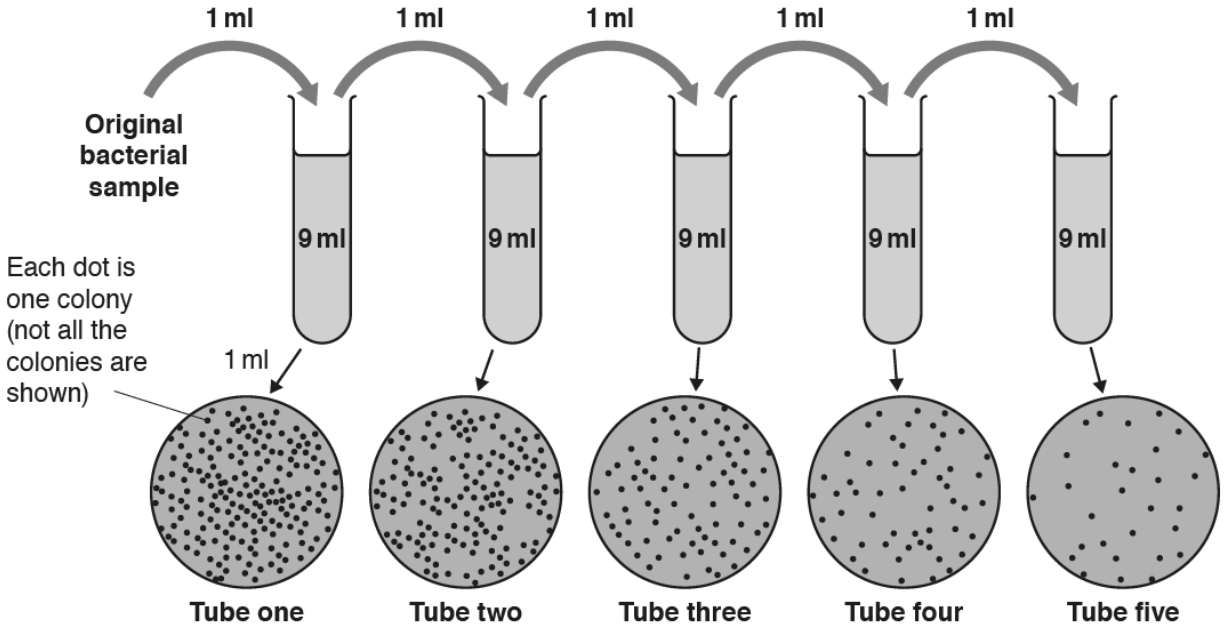
(d) The scientist counts colonies to work out the number of bacteria in a sample.

Each colony contains millions of bacteria growing close together. This makes them visible.

Each visible colony is known as a colony forming unit (CFU).

When the concentration of bacteria in a sample is high, a serial dilution is done.

Look at the results of a serial dilution.



Tube one contains 1 ml of the original sample and 9 ml of distilled water.

The dilution factor of tube one is 10.

The scientist then takes 1 ml of the mixture from this tube and adds it to the next.

(i) What is the final dilution factor in **tube five**?

Final dilution factor = ... **[1]**

Only the higher ability candidates could work out the correct dilution factor. This is a very challenging concept and was targeted at high ability candidates.

Question 14 (d) (ii)

(ii) The scientist puts 1 ml from each tube onto a separate agar plate.

The scientist then leaves the bacteria to grow so that the bacterial colonies become visible.

They use this formula to calculate the number of bacteria in the original sample:

number of bacteria in the original sample = number of CFU in sample × dilution factor

There are **29** CFU grown from the sample taken from **tube 5**.

Calculate the number of bacteria in the **original** sample.

Give your answer in **standard form**.

Number of bacteria in the original sample = ... CFU per ml **[2]**

Most of the candidates were able to take their answer from Q14(a)(i) and multiply it by 29 to provide an answer. A few of these candidates did not use standard form in their answer so were only credited with one mark.

Question 15 (a) (i)

15 The diagram in **Fig. 15.1** shows events that occur during human sperm production.

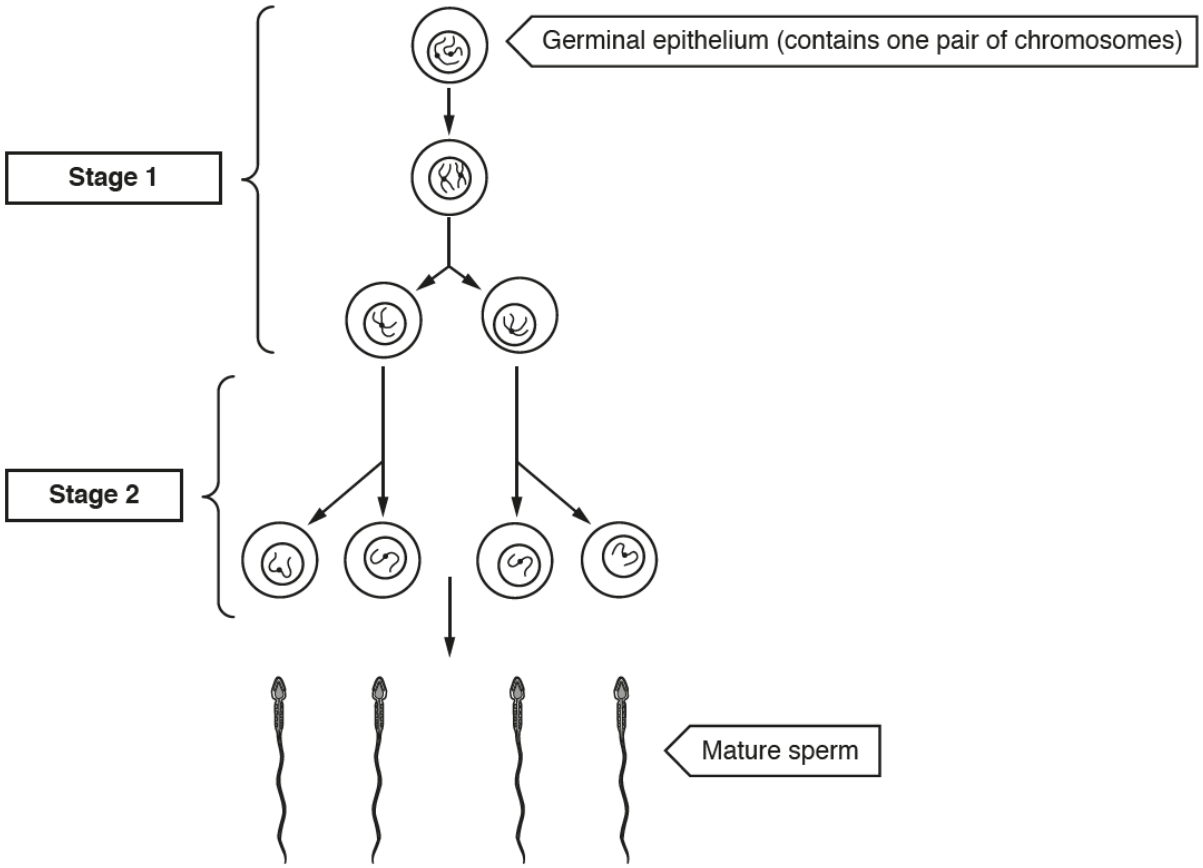


Fig. 15.1

(a) (i) Cells in the germinal epithelium have the ability to turn into sperm cells.

Which term describes cells that have the ability to turn into specialised cells?

..... **[1]**

The majority of candidates provided the correct answer of stem cells. The most common incorrect response was cell differentiation where candidates had described the process of germinal epithelium cells specialising to become sperm cells.

Question 15 (a) (ii)

(ii) Compare the number of chromosomes in human germinal epithelium cells and human mature sperm cells.

..... **[1]**

Many candidates misinterpreted the diagram and assumed that the germinal epithelium cells only had one pair of chromosomes.

Question 15 (b)

(b) Describe the events that occur at **Stage 1** and **Stage 2** in **Fig. 15.1**.

.....

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.....

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..... **[2]**

Candidates all attempted a description with many being credited with at least one mark. Usually this was for either chromosomes replicating in stage 1 or for chromosomes splitting in stage 2.

?	**Misconception**	A common misconception is to assume that stage 1 was mitosis producing diploid cells and stage 2 was meiosis producing haploid cells.

Question 15 (c)

(c) Sperm production occurs best at 35.0 °C due to the enzymes involved.

Explain why the testes are positioned outside of the body cavity.

.....

.....

.....

..... **[2]**

Many of the candidates demonstrated an understanding of enzymes to explain that the warmer conditions inside the body may lead to the denaturing of the enzymes. Lower ability candidates were not specific enough in their explanations, for example they simply stated that the enzymes wouldn't work at their best if the testes were inside the body, rather than demonstrating that they knew the enzymes would be denatured.

?	**Misconception**	A common misconception is to assume that enzymes denature in both hot and cold conditions.

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